WHAT IS CLAIMED IS:

1. A method of producing substitute natural gas comprising the steps of:

preparing a thermal plasma reactor having a thermal reactor chamber and arc electrodes located in the reactor chamber;

supplying solid carbon materials into the reactor chamber to form a large number of minute arc passages in the carbon materials;

supplying electric power to the arc electrodes to create arc discharge plasmas in the minute arc passages, respectively;

passing steam through the minute arc passages to react with the solid carbon materials under the presence of the arc discharge plasmas to produce synthesis gas containing H_2 and CO; and

introducing the synthesis gas into a methanation catalyst of a methanation reactor to synthesize substitute natural gas.

2. The method of claim 1, wherein the thermal plasma reactor has an upstream side formed with a steam generating zone and a downstream side formed with a reacting zone, and further comprising the steps of:

supplying feed water into the steam generating zone of the thermal plasma reactor to form the steam at the upstream side thereof;

cooling the substitute natural gas to separate condensed water; and

circulating the condensed water into the steam generating zone to be converted into the steam.

3. The method of claim 1, further comprising the steps of:

controlling the electric power supply to vary the temperature of the arc discharge plasma for thereby controlling a H_2/CO ratio at a given value.

4. The method of claim 1, further comprising the steps of:

circulating a portion of the synthesis gas into the thermal plasma reactor.

5. A method of producing substitute natural gas comprising the steps of:

preparing a thermal plasma reactor having a thermal reactor chamber and arc

discharge electrodes located in the reactor chamber;

supplying solid carbon materials into the reactor chamber to form a large number of minute arc passages in the solid carbon materials;

supplying electric power to the arc electrodes to create arc discharge plasmas in the minute arc passages, respectively;

passing steam through the minute arc passages to create arc discharge plasmas for causing the steam to react with the solid carbon materials under the presence of the arc discharge plasmas to produce synthesis gas containing H_2 and CO;

detecting concentrations of H_2 and CO for producing H_2 and CO detection signals;

calculating a H_2/CO ratio from the H_2 and CO detection signals to produce an arc current control signal;

adjusting the electric power to be supplied to the arc electrodes in response to the arc current control signal for controlling arc discharge current thereof to control the temperature of the arc discharge plasma for thereby adjusting the H_2/CO ratio at a given value; and

introducing the synthesis gas into a methanation catalyst of a methanation reactor to synthesize substitute natural gas.

6. The method of claim 5, wherein the thermal plasma reactor has an upstream side formed with a steam generating zone and a downstream side formed with a reacting zone, and further comprising the steps of:

supplying feed water into the steam generating zone of the thermal plasma reactor to form the steam as the plasma gas at the upstream side thereof;

cooling the substitute natural gas to separate condensed water; and

circulating the condensed water into the steam generating zone to be converted into the steam.

7. A substitute natural gas production apparatus comprising:

an arc plasma reactor having a solid carbon supply port, a feed water supply port, an insulating casing formed with a synthesis gas outlet, an arc plasma chamber formed in the insulating casing, arc discharge electrodes located in the arc plasma chamber, and a plurality of minute arc passages formed in solid carbon materials filled in the arc plasma chamber;

a feed water supply pump for supplying feed water into the feed water supply port to cause the feed water to be converted into steam;

an arc discharge power supply for supplying electric power to the arc discharge electrodes to cause arc discharge plasmas to be generated in the minute arc passages such that the steam reacts with he solid carbon materials to produce synthesis gas containing H_2 and CO; and

a methanation reactor having a methanation catalyst for converting the synthesis gas into substitute natural gas.

8. The substitute natural gas production apparatus of claim 7, further comprising:

a condenser unit coupled to the methanation reactor for cooling the substitute natural gas to separate condensed water therefrom; and

a recycle line for recycling the condensed water to the arc plasma reactor to form the steam therein.

9. The substitute natural gas production apparatus of claim 7, further comprising:

a first detector located in the arc plasma reactor for detecting a H_2 concentration in the synthesis gas to produce a H2 detection signal;

a second detector located in the arc plasma reactor for detecting a CO concentration in the synthesis gas to produce a CO detection signal;

a controller responsive to the H2 and CO detection signals for producing an electric power control signal; and

an electric power controller responsive to the electric power control signal for controlling the electric power supply to be supplied to the arc discharge electrodes for adjusting the temperature of the arc discharge plasmas such that a H_2/CO ratio is maintained at a given value.